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Income Inequality and the Probability of Violent Revolt

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This paper examines the effect of income inequality on the impetus of an organized dissident group to initiate a "revolt" in an attempt to wrest power from the government regionally or countrywide. After suggesting alterations and extensions of a mathematical framework developed by Blomberg, Hess, and Weerapana (2004) income inequality, economic growth, urbanization, and political rights data from 102 countries from 1972-1999 are used to determine their respective influences on the likelihood of a revolt being initiated in a given year. Income inequality as measured by the Gini coefficient is found to be statistically significant in determining the likelihood of the start of politically motivated conflict, as is political openness, and economic growth while the overall predictive power of the model is found to be weak.

1. Introduction

The relationship between economic conditions and political climate has been examined extensively. The aspect of the political environment of particular interest in this paper is the likelihood of non-electoral attempts to seize governing power given certain economic conditions. Previous authors have studied the relationship between economic growth, investment, or income inequality and various measures of political violence (Gurr, 1970; Muller and Seligson, 1987; Blomberg and Hess, 2002; Feng, 2003; Blomberg, Hess, and Weerapana, 2004). The causal relevance of economic inequality in attempts to oust a governing body has been considered by some; however, its affect has been primarily examined in the context of individual countries over time rather than across countries. This paper looks at the effect that the level of inequality in different countries has on the respective likelihood of revolt in each. After a review of background literature I present a theoretical model that links economic conditions to the decision of an organized dissident

group to either revolt or accept the status quo. The empirical analysis consists of cross-sectional data from 102 countries over the period of 1972-1999. In concordance with the implications of the model of Blomberg, Hess, and Weerapana (2004), Collier (2004) as well as the work of Muller and Seligman (1987) it is argued that, controlling for various other economic and social factors, the likelihood of revolt in a country in a given year is positively correlated with that country's level of income inequality.

2. Literature Summary

Coups d'etat, guerilla warfare, and terrorist attacks all constitute means of political violence that serve to either influence or remove the governing body of a nation. The decision to participate in political actions such as these has been reviewed by various authors. Obviously, the choice to participate in any such potentially violent political activity is not determined solely, or perhaps even primarily, by economic considerations. The influence of beliefs and the level of unity within a cultural or political group on the probability of attempted terrorist attacks have been examined by Epstein and Gang (2002), Bernholz (2003), and Wintrobe (2002). Similarly, the relative level of centralized power within a country as an incentive to participate in violent political activity has been studied by Frey and Luechinger (2004). Krueger and Malečková (2003) have examined the sociological background informing those who participate in terrorist activities. An entire field dedicated to the study of the social and political structures that lend themselves to violent political revolt exists within the discipline of political science. The aim of this paper then is to demonstrate that income inequality is one influential factor among others that determine the probability of violent revolt, not that income inequality is necessarily the sole or even most influential arbiter.

The theoretical foundations that link income inequality and the likelihood of extralegal political action are closely related and indebted to literature concerned with the relation of political stability and macroeconomic indicators. Many works have contributed to an explanatory scheme of how and why economic expansion and contraction tend to influence the provision of political rights and civil liberties. Some have argued that increased prosperity in terms of increased real per capita GDP distributed among a significant portion of the population will tend to increase popular receptivity to democratic rule (Lipset, 1959; Leftwich, 1996; Feng, 2003; Friedman, B. 2005). A divergent but similar argument favors the structure, rather than magnitude, of economic interaction as being the primary economic influence on governmental character. This is to say centralized command economies, or the feudal system, or free-market forms of economic interaction that generate the same per capita income distributed among the same proportion of citizens would each influence receptivity to democratic rule in differing degrees. According to this view, more diffuse economic rights tend to encourage political participation and opposition to centralized or authoritarian rule and economic characteristics such as robust growth and increased trade tend to result in democratic governance (Friedman, M. 1962; Putnam, 1993; Huber, Rueshmeyer, and Stephens, 1993).

These theories concerning the affect of economy on governmental structure are not universally supported. Barro sees "the (theoretical) connection between political and economic freedom as controversial" (Barro, 1998) Citing the work of Sirowy and Inkeles (1993) as well as Przeworski and Limongi (1993), Barro argues that economic conditions like high growth rates and low income inequality do not have a clear connection to a free

political environment. In contrast to his doubts concerning the theory underlying the relationship between robust macroeconomic health and democratic rule, Barro finds a "strong empirical regularity" in the relationship (Barro, 1998, pg.52).

Rather than focus on the phenomenon of state-formation through the effects of growth or income inequality, this paper focuses on the initiation of extralegal political conflict. Theoretical work regarding the relationship between economic inequality and the probability of extralegal political activity in the form of revolution is extensive. Ted Robert Gurr (1970) and Charles Tilly (1973) have authored theses that, in addition to sociological characteristics, suggest that the economic reality faced by potential dissidents plays a major role in their decision to participate in a rebellion.

An alternative thesis authored by Theda Skocpol and Jeff Goodwin (1989) holds that economic conditions within a country, including economic inequality, do not play a significant role in prompting revolutions. In response to the theses of Gurr and Tilly they argue that the events and conditions that prompt revolt, instead of being primarily related to social and economic conditions, are related to the role and stature of the state as well as the ability of the populace to mobilize. In their view, "socioeconomic deprivation", poverty, and general economic inequality are constants for the populace that would potentially participate in a revolt, namely peasants, the proletariat, and the middle-class. They state that "the 'misery breeds revolt' hypothesis does not explain very much. Leon Trotsky once wrote that the 'mere existence of privations is not enough to cause an insurrection; if it were, the masses would be always in revolt.'"(McClintock, 1998, p.23) Among the important insights offered by Skocpol and Goodwin, the level of organization

and authoritarianism of the incumbent governing body will be of particular importance in the construction of the model.

A moderate rebuttal of this formulation of the structure and mechanisms of revolution Timothy Wickham-Crowley (1989) examines the correlation between the socioeconomic conditions in twenty-four cases of successful, failed, and partially successful revolutionary movements in Latin America. His study focuses on the effects that peasant support for revolution, guerilla military strength, incumbent regime type, land distribution, and other sociological variables had on the success of revolutionary movements. He found that Skocpol and Goodwin's thesis is compelling in a certain sense, but mistaken in proposing that inequality plays no part in the formation of revolutionary movements. His analysis indicates that regime type played a major role in the success and catalysis of revolutionary movements. In addition to this affect of regime type, he determined that the Latin American countries that experienced an increase in the concentration of land ownership in a given period were much more likely to experience a revolution in subsequent periods than countries that had relatively disperse land ownership.

This focus on the affect of land distribution on the likelihood of revolution has been criticized by Muller and Seligson (1987) and McClintock (1998). These analysts argue that land ownership is a proxy for the real motive of revolt. They suggest that it is income inequality, or inequality in the distribution of the means by which one achieves a given level of well-being, that prompts revolution, not landownership as such. Muller and Seligson address multiple theories of revolution. An important point they make in response to those who argue that worsening, or consistently poor, economic conditions

have little to do with the formation of extralegal political movements given their ubiquity, is that inequality may exist in every society but it exists in differing degrees. Obvious as this observation appears, it serves as a point of departure for the analysis of influence of income inequality on the *level* of political violence. Controlling for economic development, political repressiveness, and the intensity of separatism, their empirical analysis regresses the number of political deaths per million people in a given country on the proportion of income held by the richest quintile. The affect of income inequality was found to be statistically significant.

This paper draws from the conceptual basis of Muller and Seligson (1987), but differs from their work in various ways. First, they utilize the number of politically-related deaths in a country to measure the *level* of political violence. The analysis in this work focuses on the choice to attempt to undertake a revolt or not. The occurrence of a "revolution start" in a given year will be determined using the definition of revolution as well as the starting dates given by Gurr and Harff (2000). The likelihood of this categorical event will then be related to the level of income inequality. As mentioned above, Muller and Seligson use the proportion of income accruing to the richest 20% of the population to reflect income distribution across the population. They suggest that the proportion of income held by the richest portion of the population is more salient in the consideration of those who might opt to revolt than a measure, such as the Gini coefficient, which is more sensitive to income disparities in the middle deciles of the national income distribution. It may be true that a measure which is reactive to unequal distribution among middle-income groups is not an ideal measure of income inequality in a society, but some inclusion of the levels of income distribution among those who are

not in the highest income quintile is preferable to none. It is conceivable in the relationship proposed by Muller and Seligman that two countries may have the same proportion of income accruing to the richest 20% of the population yet have highly divergent levels of income distribution among the remainder of society. Presumably, there would be differing resultant probabilities of political violence, but these differing probabilities would not be captured by the use of just the income of the richest quintile. Thus, some measurement which incorporates the income concentration in the rich *as well as* poorer part of the population would seem preferable. Additionally, this paper provides a different conceptual framework than that of Muller and Seligman.

Collier and Hoeffler (2004) examine similar effects of income inequality in determining the likelihood of civil war. In a paper concerning the motivations of dissident groups in pursuing violent political action, they examine the predictive power of a large group of variables such as per capita GDP, education levels, percent of land forested, and a constellation of other potential determinants. The number of variables included in the regression is impressive. However, there are multiple problems with their model that are absent in the empirical analysis below. For instance, they aggregate economic variables, such as per capita growth and income inequality, across five-year intervals and use these aggregates to determine the likelihood of a civil war beginning in the same five-year interval. The issue of simultaneous determination between growth and the occurrence of civil war in the same interval of time is not addressed. Inclusion of a variety of collinear variables also appears to reduce the efficacy of the regression. While this paper may suffer from omission of relevant variables such as those that might capture the degree of divisiveness in a society or availability of warring capital, the work

of Collier and Hoeffler (2004) seems to suffer from inclusion of irrelevant variables. This paper also differs from their work in its definition of revolt, the time interval used to measure the beginning of conflict, and its explicit extension and application of a theoretical model of the economic motivations for revolt.

The work drawn upon most heavily is the theoretical work of Blomberg, Hess, and Weerapana (2004). Prior to developing their mathematical model, though, Blomberg and Hess (2002) examined the empirical relationship between economic growth and external and internal armed conflict. To model this relationship they use two-stage Markov processes wherein the conditional probability of conflict, internal or external, is measured given the state of growth, defined as either positive or negative, in the previous year. Whereas in this paper a regression utilizing the magnitudes of the determinant variables (e.g. growth, inequality) is estimated, Blomberg and Hess compare the probability of internal conflict occurring in some period t contingent upon the categorical variable of growth(contraction) and internal or external peace(conflict) in period t-1. The use of Markov processes in examining the correlation between growth and conflict or peace helps in the simplification of the analysis, and after controlling for different country characteristics such as the region and government type they found a statistically significant relationship between recession in an economy and increased likelihood of conflict in the country the following year. Additionally, non-African countries as well as those with a democratic form of government were less likely to experience political in periods following recession.

In a later paper, Blomberg, Hess, and Weerapana (2004) borrowed the general framework of a model developed by Tornell (1998) to construct a theoretical model for

the decision of political dissidents to undertake a violent attack on the government based on a constellation of economic and social factors. Tornell's model examines the decision of an economically and politically powerful group to willingly "relinquish its privileges" so as to make it economically worse off than before. In the long term, though, circumstances are better for the group vis-à-vis its economic opponents than they otherwise would have been. An important aspect of Tornell's model that is present in Blomberg, Hess, and Weerapana's model as well as this paper is the access that each group has to the economic resource. Each group has open access to the resource and their extraction rates are constrained by the condition that the government extraction rate exceeds that of the dissident group. These conditions cause peaceful status quo to eventually devolve into economic crisis due to the rational decision by each group to over-extract from the stock of economic resources. This leads to two possible reform patterns: simultaneous reform by both groups, or an earlier reform by one group.

Blomberg, Hess, and Weerapana alter this conceptual scheme to fit the considerations of potential political dissidents. They examine how, within their framework, political conflict might be influenced by the rate of growth, relative levels of appropriation of economic resources by the two groups, and the likelihood of success of a revolt.

In their earlier empirical examination of conflict and economic conditions Blomberg and Hess (2002) argue that as growth declines or as a contraction worsens, the payoff to dissidents of maintaining the status quo rather than revolting declines. Eventually the payoff to revolt outstrips the benefits of maintaining the status quo, thus the dissident group probabilistically chooses to revolt. They also mention that

contraction of the economy is not the only way in which this cost-benefit tradeoff changes. They identify the relative rate of appropriation of economic resources by potential rebels and those in power as a characteristic of the model that also alters the probability of revolt.

3. Conceptual Framework

The conceptual model and mathematical framework developed in the analysis of Blomberg, Hess, and Weerapana (2004) is extended here in an analysis of the probability of revolution in countries with differing levels of income inequality.

In a given time period t in country j there exists a stock of resources, a_t. This stock of resources could be an asset such as natural resources (e.g. lumber, oil, coal, fish) or fiscal resources. In this paper the GDP of a country is taken to reflect the size of this stock of economic resources. The stock is appropriated by two organized groups—those who are in power, or "oligarchs", and those who are not in power, or "dissidents"—as well as a third group that constitutes the remainder of society.* Each group extracts resources from the total stock at differing rates. Oligarchs extract resources at a rate of γ, dissidents extract resources at a rate of δ, and the remainder of society extracts at some rate λ.[9] The extraction rates of each group may total to a rate greater than the raw growth rate of the resource. In fact, as in Tornell (1998) and Blomberg, Hess, and Weerapana (2004) the two groups rationally extract at a rate greater than the growth rate of the stock. Additionally, oligarchs always extract resources at a greater rate than dissidents, that is,

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* This theoretical model borrows substantially from "An Economic Model of Terrorism" by Blomberg, Hess, and Weerapana (2004), who in turn borrowed the main body of their model from "Reform from Within" by Tornell (1998).

[9] For the sake of simplicity, the marginal utility of the resource is constant. However, it is reasonable to believe that the marginal utility of the modeled resource would be diminishing. Incorporating this aspect of the resource would strengthen the implication that increased inequality would increase the payoff of revolt.

$\gamma > \delta$. This extraction of resources from the common stock can be conceived of as the income accruing to each group. The stock of resources has a raw growth rate of κ. As the size of the economy is taken to reflect the size of this stock of resources, economic growth reflects the value of this parameter. The growth of the stock of economic resources from which these groups appropriate is given as:

$$\dot{a}_t = \kappa\, a_t - \gamma\, a_t - \delta\, a_t - \lambda\, a_t$$

The stock of resources appropriated by just the dissident group and the oligarch group is affected by the raw growth rate of the total stock and the extraction rate of the remainder of society. To simplify the formulation the raw growth rate and the remainder of society's extraction rate will be combined to show the effective growth rate $\beta = (\kappa - \lambda)$ of the stock of resources appropriated by only dissidents and oligarchs. The growth of this stock is given as:

$$\dot{a}_t = a_t\,(\beta - \gamma - \delta)$$

In every time period the dissident group has three options. They can either choose to accept the status quo, attempt to effect legal change, or undertake a "rebellion". The cost of rebelling is an expended fraction of the economic resources appropriated from the total stock. That is, at some time τ dissidents may choose to form a rebellion that lasts h periods, expending some fraction $q^R \in (0,1)$ of the economic resources it appropriates. The dissident group's expenditure during the h periods of revolt cannot exceed its cumulative appropriation from the stock of resources during the h periods of revolt. The model also incorporates a subjective time preference, p, for the consumption of potential resources. A successful rebellion results in the deposition of the oligarchs

and a new extraction rate for dissidents. Their new extraction rate is γ—that of the deposed oligarchs. The oligarch group may then dissipate into the indifferent third party or remain as an organized group.

The dissident group faces uncertainty as to the outcome of an attempted revolt. The parameter θ reflects the expected likelihood of a successful revolt. Though in their model they do not link the parameter θ to the proportion of resources the dissident group expends in the revolt, Blomberg, Hess, and Weerapana (2004) mention that the likelihood of success is probably positively correlated with dissidents' proportional expenditures. However, it is not just the dissidents' proportional expenditure of resources but its total resource expenditure that influence its likelihood of revolutionary success. Ceteris paribus, it would be reasonable to assume that a dissident group would be more likely to succeed if they dedicated a greater *absolute* amount of resources to a revolt, not just a greater *proportion* of their resources.* Thus, as the dissidents' extraction rate increases relative to the oligarchs' their likelihood of success increases; and as their extraction rate declines relative to that of the oligarchs, their likelihood of success decreases. Therefore, in addition to various social and political characteristics of the country, the probability of success, θ, is a function of the relative extraction rates of the dissidents. All this implies that $\partial(\theta)/\partial(\gamma\text{-}\delta) < 0$.

The second option—a legal attempt to change the policy of the government—takes a similar form. The extraction rates (γ, δ), effective growth rate (β), the duration of

* This is in accord with the work of Grossman (1991) who links potential dissidents' allocation of time between labor and revolt with the soldiering technology of the oligarchs and the dissidents and, by extension, their likelihood of success.

the legal action (h periods), and the likelihood of success, θ, are the same.[9] One difference is the lower cost of this action. The cost of a legal attempt to depose the oligarchs is $q^L \in (0,1)$ and defined as $(1 - \alpha)\, q^R$. The α term, which ranges from 0 to 1, captures the effectiveness of legal political dissent. As more effective channels for legal political influence open α increases and the cost of a legal attempt to change the government relative to the cost of a revolt decreases. The payoff for a successful legal action also differs. In the event of a successful attempt to legally change the government the extraction rate of the dissidents increases but not by as much as it would in the case of a successful revolt. When the present oligarchic group is removed legally, the new governing group concedes a share of its extraction to the dissidents. The new extraction rate of the dissident group is some fraction, π, of the extraction rate that it would have enjoyed in the case of a successful revolt (γ) and exceeds its old extraction rate, $\pi\gamma > \delta$. Additionally, the new oligarch extraction rate, χ, equals $\delta + (1 - \pi)\gamma$. Thus, the new extraction rates sum to the old extraction rates ($\chi + \pi\gamma = \gamma + \delta$).

The dissident group could also choose to maintain status quo by not attacking. This third option forgoes both the costs and benefits associated with rebellion or legal change.

There are a few additional assumptions borrowed from the Blomberg, Hess, and Weerapana model that are important to mention. First, though it is counter-intuitive, the model assumes that a revolt occurring in country j will not affect that country's economic growth rate. Numerous authors (Barro, 1998; Elbadawi, 1999; Collier, 1999; Feng,

[9] Though modeling the probability of legal success and extralegal success as equal may appear odd, recall that for this given level of probable success the resources expended in a revolt are set to be greater than those expended in a legal political action.

2003) have found that economic growth is negatively effected by political volatility. Thus, it would appear that in the case of a revolt the growth rate would be reduced, both in the period of revolt and the period after revolt. Additionally, the dissident and oligarch extraction rates are apparently not predicated upon any type of technological expertise or other particular group characteristics. This assumption allows any group, regardless of the human capital of the group, to fill the role of "oligarch" and extract at the oligarch rate. Given that a group's appropriation of goods from the stock of economic resources does depend on their respective levels of education, technological expertise, and in many instances, the trust of international investors, it might be more convincing to model the dissident's resulting extraction rate in the event of a successful revolt as greater than its prior extraction rate δ, but not as great as the oligarch's prior extraction rate γ. However, these assumptions greatly simplify the model and allow it to serve as an informative framework in which the relation between economic circumstances and the decision to initiate a revolt may be better understood.

To determine the benefits accruing to dissidents in any of these situations we integrate their payoff functions over each of the three time periods—the time before potential, during, and after the potential revolt. In the case that the dissident group chooses not to revolt their benefit function is the same for each period and takes the form:

$$S(\tau) = \int_0^\infty \delta a_0 e^{(\beta-\gamma-\delta-p)s} ds \tag{1}$$

To determine the benefit function that arises in the case of a revolt, two components that are absent in Equation 1 must be added to Equation 2. First, the cost that is expended (q^R) during the h periods necessary to overthrow the government is included in the

second integral below. The third integral reflects the resulting extraction rate in the event of failure, which occurs with probability (1- θ), and the fourth integral shows the extraction rate in the case of success, which occurs with probability θ.

In this model, as in Blomberg, Hess, and Weerapana, it is assumed that the government does not seek any retributive revenge. If the dissident group in fact fails in their attempt to overthrow the government this assumption leaves them with the same benefit function that they had prior to the revolt. The payoff to revolt takes the form:

$$R(\tau) = \int_0^{\tau} \delta a_0 e^{(\beta-\gamma-\delta-p)s} ds + \int_{\tau}^{\tau+h} \delta a_0 e^{(\beta-\gamma-\delta-p)s}(1-q^R) ds$$
$$+ (1-\theta)\int_{\tau+h}^{\infty} \delta a_0 e^{(\beta-\gamma-\delta-p)s} ds + \theta \int_{\tau+h}^{\infty} \gamma a_0 e^{(\beta-\gamma-\delta-p)s} ds \tag{2}$$

The expected benefit function in the case of a legal attempt to change the government takes a similar form. Up until time τ the dissident group has the status quo payoff. The fraction of income expended on legal political action during the *h* periods of activity is included in the second integral. The payoff resulting from a failed attempt and the payoff resulting from a successful attempt are multiplied by their respective likelihoods.

$$L(\tau) = \int_0^{\tau} \delta a_0 e^{(\beta-\gamma-\delta-p)s} ds + \int_{\tau}^{\tau+h} \delta a_0 e^{(\beta-\gamma-\delta-p)s}(1-\alpha)q^R ds$$
$$+ (1-\theta)\int_{\tau+h}^{\infty} \delta a_0 e^{(\beta-\gamma-\delta-p)s} ds + \theta \int_{\tau+h}^{\infty} (\pi\gamma) a_0 e^{(\beta-\chi-\pi\gamma-p)s} ds \tag{3}$$

In the process of deciding whether to revolt or maintain the status quo, the dissident group would compare the costs and benefits implied by the above functions. In order to determine the economic outcome of this decision we simply look at the difference between the two integrals:

$$R(\tau) - S(\tau) = N^R(\tau) = -q^R \int_{\tau}^{\tau+h} \delta a_0 e^{(\beta-\gamma-\delta-\rho)s} ds + \theta \int_{\tau+h}^{\infty} (\gamma - \delta) a_0 e^{(\beta-\gamma-\delta-p)s} ds$$

(4)

The difference in benefits over the period of revolt from that of status quo is the dissidents' expenditure of appropriations from the common resource stock, thus $-q^R$, the proportion of benefits expended, multiplies the integral totaling the benefits that accrue to the group over the time period of the revolt. Finally, the probability of success multiples the integral that determines the difference between the extraction rates in the event of success, γ, and in the event of failure, δ.

The process of weighing the decision to attempt a legal removal of the present governing group of oligarchs rather than accept the present political-economic situation is similar. The expected payoff to a legal attempt to remove the oligarchs would be:

$$L(\tau) - S(\tau) = N^L(\tau) = -(1-\alpha) q^R \int_{\tau}^{\tau+h} \delta a_0 e^{(\beta-\gamma-\delta-p)s} ds + \theta \int_{\tau+h}^{\infty} (\pi\gamma - \delta) a_0 e^{(\beta-\gamma-\delta-p)s} ds$$

(5)

The difference in benefits over the period of political activity, derives from the dissidents' expenditure of appropriations from the common resource stock, q^L. The proportion of benefits expended multiplies the integral totaling the benefits that accrue to the group over the time period of the activity. Note that as α approaches 1, that is, as the country becomes more democratic and more effective channels of legal dissent open, the cost of legal political action approaches 0. Finally, the probability of success multiples the integral that determines the difference between the extraction rates in the event of success, $\pi\gamma$, and in the event of failure, δ.

In order to determine the preference of a legal attempt to remove the oligarchs over a revolt or vice versa, the dissident group would compare the expected benefit functions. Subtracting the expected benefits of legal political dissent (Equation 5) from the expected benefits of revolt (Equation 4) gives the expected benefits of revolt relative to legal action:

$$N^R(\tau) - N^L(\tau) = -\alpha q^R \int_{\tau}^{\tau+h} \delta a_0 e^{(\beta-\gamma-\delta-p)s} ds + \theta \int_{\tau+h}^{\infty} (1-\pi)\gamma a_0 e^{(\beta-\gamma-\delta-p)s} ds \tag{6}$$

Though the focus of the empirical section is not on the occurrence of peaceful means of transitioning from one governing group to another, it is useful to note that Equation 6 implies that the expected benefits of revolt relative to peaceful dissent decline as the value of α rises (increase in effective democracy). Thus, the existence and efficacy of democratic institutions will play a role in determining the predicted likelihood of a revolution.

These analyses indicate that preference for revolt or status quo cannot be determine without values for the parameters of cost, appropriation rates, likelihood of success, and the value of future economic power. However, it is possible to examine the manner in which the revolt benefit function, $N^R(\tau)$, changes as various parameters increase or decrease. For instance, as the cost of a successful revolt rises or simply stays high enough, that is, as q^R rises or maintains relative dominance, the payoff of accepting the status quo increases or maintains relative to the payoff of revolt. An increase of this sort might derive from increased the government investing in increased military competence or poor internal infrastructure which dissident forces might use for transport.

What is of greater interest though is the role played by the economic parameters in the model in determining the relative benefit of revolt. Earlier work has focused on the influence of a shift in the growth rate of the economic resources from which each of the two groups draw. Assuming that the two groups are extracting at a composite rate greater than the raw growth rate of the stock, taking the partial of Equation 4 with respect to the growth parameter indicates that: $\partial(N^R(\tau)) / \partial\beta < 0$. This means that as the economy grows, the relative benefit of revolting falls, and a reduction in the likelihood of political revolt follows.

There is also the effect of changing extraction rates. How might the payoff of a revolt change as inequality in appropriation rates, or $(\gamma - \delta)$, increases. In order to examine this effect, we take the partial of Equation 4 with respect to the oligarch extraction rate, which serves as increase in $(\gamma - \delta)$ since the difference in extraction rates increases as the oligarch extraction rate rises and the dissident rate is held constant, $\partial(N(\tau)) / \partial(\gamma)$*, indicates that we cannot sign the derivative. If, as in Blomberg, Hess, and Weerapana (2004) we were to assume that the likelihood of success was independent of the inequality of appropriation rates we would find that an increase in inequality would increase the payoff to a revolt. Intuitively this means that the more extreme the wealth of the government and poverty of the dissidents the greater the benefit of a revolt. However, as suggested above, if the likelihood of success in fact depends on how well each group can equip itself by expending a portion of its extraction, the likelihood of a successful revolt decreases as income inequality rises. It is fairly straightforward to recognize that at the extreme of absolute inequality, where the oligarchs appropriate all

* See Appendix 1

economic resources and dissidents appropriate none, as well as absolute equality, the dissident group would not attack. In the case of absolute inequality due to its lack of resources with which to mount a revolt its likelihood of success would be zero, thus yielding no expected payoff. In the case of absolute equality there would be no economic motive to alter the level of appropriations through revolt. The expected benefit of revolting as income inequality increases takes on a parabolic shape, increasing as the dissident group gains the means by which to revolt and decreasing as their extraction rate grows closer and closer to equality with the oligarchs. Thus, the level of inequality that results in the highest expected payoff to revolt is moderately unequal extraction rates.

It is interesting to note that the model allows for a higher likelihood of political revolt when the proportion of economic resources by appropriated by oligarchs increases even if there is growth in the economic stock appropriated by dissidents. This is to say that if the poor get richer *and* the rich get richer, but in such a way as to increase income inequality, the poor would be more likely to revolt. This does not seem as straight forward as a scenario where in income inequality rises while the income of the dissident group is static or decreasing. This effect of the model is a product of the assumed level of information; the extraction rate of each group is known by dissidents. A motive for revolt such as this is intimated by John Stuart Mills' observation that, "Men do not desire merely to be *rich*, but to be *richer* than other men."*

* The theoretical model assumes that the relative level of appropriation of economic resources by dissidents and oligarchs is known by each group. In the case of the dissident group this is apparent in the role that the appropriation rate of oligarchs (γ) plays in their benefit function. As the oligarchs' appropriation rate increases the total benefits accruing to dissidents falls. This is an assumption central to the model and is made by both Tornell (1998) and Blomberg, Hess, and Weerapana (2004).

Extension of the Framework

The model above provides a theoretical structure for the likelihood of political violence to be chosen by a potential dissident group in a single nation as a function of changes in economic circumstances. The issue of interest is the likelihood of revolt beginning in *different* countries in a given period of time as a function of the income inequality in that period of time. Thus, there is an alteration in the conceptual scheme that underlies the mathematical model. In the above model, the dissident group extracts some portion of the common economic resource base. Over time if the resource base dwindles relative to the appropriation rates of the two groups either by way of economic contraction or an increase in the extraction rates of both groups, the likelihood of revolt increases. Additionally, if from one period to the next the appropriation rate of the oligarchs increases relative to that of the dissidents the dissident group demonstrates a higher probability of revolt. The general notion is that if the economic circumstances of the class of individuals who might participate in a revolt worsens over time, either in absolute terms or relative to their political opponents, they are more likely to revolt. This intuitively makes sense in that the group has conceptual reference to an earlier time period wherein their economic situation was not as bad.

However, this paper examines the likelihood of a political revolt as a function of income inequality in different countries and different time periods. The elimination of the strictly temporal aspect of the model implies a different form of argument. The dissident group, rather than experiencing a *change* of their appropriation rate relative to the appropriation rate of oligarchs, experiences a static level of inequality. Though the conceptual justification changes, the new scenario can be represented by the above

framework in the same manner. In the model above, which is meant to represent the expected economic gains from a revolt, the determining factors (e.g. extraction rates, growth) are not linked to earlier periods. They are independent of the past in that extraction rates or growth rates of earlier periods do not affect the expected payoff function. This indicates that the model maybe be considered as temporally independent. The general intuition is that, ceteris paribus, higher income inequality in any given country will tend to increase the expected payoff of revolting (and thus the likelihood initiation of revolt) up to a point and then the extremity of inequality will decrease the expected success rate to such an extent as to make revolt not viable.

4. Model

To examine the empirical relationship between the relative appropriation rates of economic goods by those in power and those who might participate in a political revolt, the binary variable of "revolt initiation" will be regressed on the variables of income inequality, political rights, and the growth rate of the economy from the previous time period to the present period, among others. As indicated in the model, relative extraction rates play a role in determining the expected payoff of revolt. In order to examine this implication the Gini coefficient from 102 countries from 1972-1999 will serve as proxy for the differing extraction rates. Additionally, the growth rate of the common stock will be represented by the growth rate of the economy of the given country. The empirical relationship between income inequality and the occurrence of political revolt takes the form:

$$\text{Prob}\,(Y=1) = \frac{e^{BX}}{1+e^{BX}}$$

$Y = 1$ if a "revolt" is initiated in country j in year t

0 if a "revolt" is not initiated in country j in year t

X = the vector including determinants $[x_{1jt} \ldots x_{6jt}]$

x_{1jt} = Gini value in country j in year t

x_{2jt} = (Gini value in country j in year t) ^{2}

x_{3jt} = Political rights value in country j in year t

x_{4jt} = Growth rate of the economy in country j from year (t-1) to year t

x_{5jt} = Urbanization rate

x_{6jt} = Cold War variable; 1 if year t falls before 1986

0 if year t is 1986 or later

In measuring the relationship between continuous or categorical variables and the likelihood of an occurrence it is preferable to use a regression model that constrains the estimated outcome to fall within the interval (0,1) so that the likelihood of an event occurring is neither greater than 1 or less than 0. In order to do this, a logit regression model is used. Instead of using Ordinary Least Squares to estimate the parameters for the regression, the parameters in logit models are estimated by maximum likelihood. Given k variables in the vector X this procedure determines estimates of β_0 through β_k that maximize the likelihood of observing the sample. In large samples, maximum likelihood estimation renders estimators that are normally distributed, consistent, and best in that no alternative estimator has lower variances.* Another important aspect of the logit model is that β_m cannot be interpreted as the marginal effect of an increase in variable m on the

* Hill, R., Griffiths, W., Judge, G. (2001) *Undergraduate Econometrics* p. 372-73.

dependent variable. Instead, the marginal effect of variable m on the dependent variable takes the form: $\frac{\partial \Pr}{\partial x_m} = \beta_m \frac{e^{BX}}{(1+e^{BX})^2}$. Thus, the marginal effect of an increase in the value of variable m depends upon β_m, the estimated coefficient values of each variable, and the values of variable x_1 through x_k.

5. Data

Political Revolt

The data used to determine if the dependent variable takes on a value of 1 or 0 is taken from the 2000 State Failure Task Force Report (SFTFR) (Goldstone, Gurr, and Harff, 2000). The report—an updated version of the data used by Blomberg and Hess (2002)—is a compilation and analysis of information from various institutions such as the World Bank and the United Nations that pertains to the character of and reasons for instability of political institutions and events of widespread violent conflict in most extant countries from 1955 to 1999. In order to be considered in this study, a conflict must have occurred in a nation with a population of 500,000 or more. The report uses a typology of conflict which assigns all the 114 state "failures" to one of five categories.

Revolutionary War is a period of sustained conflict between the existing government and an organized and politically motivated group that aims to take power from the government in the whole country or a specific region. *Ethnic War* is a period of sustained conflict in which "national, ethnic, religious, or other communal minorities" challenge the government in order to prompt "major changes in their status." For a conflict to be included in either the *Revolutionary War* or *Ethnic War* categories more than 1,000 people must have participated and at least 100 people must have died in direct result of the conflict. *Adverse Regime Changes* are characterized by abrupt shifts in the

governmental structure that include state collapse, factional conflict within the ruling elite, and eventually lead to greater authoritarianism and narrowing of political rights. *Genocides and Politicides* are policies enacted by the government or a dissident group that lead to the death of a "substantial portion of a communal or political group." And an event specified as *Complex* demonstrates characteristics from multiple categories.

The conflicts between governmental and dissident groups in each of the four categories are characterized as being at least in part political. Every conflict in the category of *Revolutionary War* fit the criteria for a revolt. According to the definitions set forth by the SFTFR these revolts were undertaken with the aim of overthrowing the incumbent political group either nationally or in a region, and in some cases resulted in a successful deposition of the government. These conflicts are also assumed at a risk to the dissident group.

The majority of events in the categories of *Ethnic War* and *Genocides and Politicides* were also included. However, there were a few events from each category that did not fit the description of extralegal political activity aimed at gaining political power for the dissident group. For example, the ethnic war between the Tutsis and the Hutus in Rwanda was politically motivated at first, and in each year of the SFTFR that the conflict was described as such the conflict is included in the data as a "revolt", but at various points in the conflict there were no clear political power motivations for the dissident group. Additionally, most genocides included in the report were conducted by governmental forces and thus do not fit the description of a revolt. Some politicides were undertaken by dissident groups within a country or region that were attempting to influence the government. These events were included as revolts given that there aims

implied an alteration of the policies of the incumbent regime. Once again though, most politicides were carried out by the governing group and thus do not fit the criteria of a revolt.

The category of *Adverse Regime Changes* was not considered an attempted revolt. The majority of these militant actions took the form of a coup. As discussed by Farcau (1994) and Goldstone, Gurr, and Harff (2000), most coups are carried out by authorities backed by the military. Those who are members of the military, the officer corps in particular—the main body from which coup leadership derives—are dependent upon the strength and existence of the military as an institution for their economic well-being. This implies that economic circumstances that tend to increase military strength and longevity such as increased taxes and investment in soldiering capacity are preferable circumstances. As the extraction rate of the oligarchs increases, through various means but especially through taxes, the motivation to attack the government declines. This indicates that the characteristics of the majority of coups are not the type of revolt examined in this paper, namely those where the dissident group is competing with the governmental group for a common resource.

As mentioned above, an earlier paper examining the relationship between violent political conflict and income inequality by Muller and Seligman (1987) used the number of deaths related to political conflict per million to quantify the level of political conflict in a given country. This method differs from the method proposed in this paper in a few notable ways. Though their work is aimed at measuring the occurrence of revolutionary activity and in large part does, their use of "political deaths" relates the intensity of political conflict in general, not necessarily *revolutionary* conflict. As is evidenced by

the categories used in the SFTFR, political conflicts, and thus deaths related to political conflicts, can take a form other than that of a revolt be it an authoritarian coup, mass riots, terrorist activities, or otherwise. In including deaths that occur in the events that do not fit the criteria of a revolt, their conflict variable suffers a bias. Another important difference in their method is that it reflects the *level* of political conflict. The phenomenon that this paper examines is the choice of an organized to revolt as opposed to accept a state of status quo. The variable used to reflect conflict is binary and non-continuous. Though the definitions used in the SFTFR implicitly assume a certain level of conflict, in terms of political deaths, in order for an event to qualify as a "state failure" rather than "terrorist attack" or "violent movement" this criterion doesn't distinguish between the intensity of violent conflicts that are considered "failures". This way of defining political conflict better fits the phenomenon of interest, namely, the probability of a *choice* being made to pursue violent conflict.

Income Inequality

The modeled relationship of relative appropriation rates of economic resources suggests that it would be desirable to use data that reflect the government and the constellation of groups that influence the policies of the government to represent the appropriation rate of "oligarchs". This might be accompanied by data for the demographic that tends to prompt and participate in revolutions. According to Huntington (1968), school teachers, and recent college graduates, along with peasant farmers and industrial workers represent the body of potential revolutionaries in most countries. In representing the extraction rates of each group we would wish to exclude the proportion of income accruing to sections of society indifferent to the occurrence of revolution or peace.

Obtaining data this precise was not feasible. Rather than using exact measures of the appropriations of each theoretical group to quantify levels of inequality, the Gini coefficient of income is used. Just as Blomberg, Hess, and Weerapana (2004) used the growth rate of per capita GDP to infer the growth rate, β, of the stock of assets, a_t, the income of portions of the population can be used to infer the relative dissident and oligarch extraction rates. The Gini index is a measure of the concentration of some characteristic or phenomenon, in this case the income distribution among the members of a country. The coefficient ranges from 0 to 100. High values indicate a high concentration of income and thus an unequal distribution while low values indicate low concentration and thus a relatively equal distribution. This measurement includes all members of the citizenry of the given country. This means that the incomes of those who do not have a clear interest in participating in or preventing a revolt are included in this measurement of income concentration.

The use of the Gini coefficient as a measure of the distribution of the means by which members of a society obtain a given level of well-being has been criticized by many authors for various reasons. As for the measurable variable that should be used in the Gini calculation of "economic appropriation" inequality there are many opinions. The traditional variable used is the income of individuals or families. However it has been criticized for various reasons. In lieu of income, consumption and expenditure have been offered. Consumption is closer in relation to the intertemporal well-being of a family or individual than income, gross or net, if they are able to borrow or lend. Access to the capital markets necessary for the smoothing effect of borrowing and lending is

fairly common in most regions of the world.* Additionally, underreporting is less of a problem with consumption than it is with income.[9] However, data on consumption rarely have been collected in many countries during the time period that will be examined. In the use of income data further problems are created by the variation in the definitions of "income" used by those who conduct the surveys. This though is remedied to a large extent in this study by the use of a consistent methodology in constructing income Ginis.

The database used to collect income inequality data, the World Institute for Development Economics and Research (WIDER), reports over 3000 Gini coefficients for most countries in the world since the mid-1950s. As a result of the divergent views as to the manner in which Ginis should be calculated, WIDER reports many different types of Ginis. Dependent upon the attribute that was examined by each survey the Gini may be based upon expenditure differences, monetary income differences, or various other indicators. However, for the sake of consistency of analysis WIDER uses a standardized method of calculating the Gini coefficients which is the same regardless of the variable reported. In addition to the standardized method of calculation, the database provides information as to what type of attribute the reported Gini is based on and the quality of information in the report. As might be imagined, different agencies in different nations are more or less assiduous in their collection of fine details about any of the economic indicators used for the Gini calculation. Thus, the database provides an index that ranges from 1-4 for the reliability of the information within the report upon which the calculated Gini is based. A value of 1 represents highest reliability and 4 represents lowest.

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* Ferranti, D., Perry, G., Ferreira, F., Walton, M. (2004) *Inequality in Latin America: Breaking with History* p.36

[9] Ibid. p.36

The methodology used to choose Ginis for the data in this work consisted of a few consistent steps. Primarily all observations in the WIDER database that were given a quality score of 4, the lowest, were eliminated from the data set. Next, each Deininger and Squire (2004) observation that was not calculated based on consumption or expenditure was included. Finally, the rest of the Ginis used were taken from different surveys based on the definition of income that the survey used.

Due to survey costs each country in the sample set does not have a reported value of the Gini coefficient for each year. In order to avoid losing information from the political rights and economic growth variables, whose annual values are of interest, Gini values were constructed in a systematic manner for years within a five year proximity of observed Gini values. The observations that were presented in the database were used to interpolate and extrapolate these constructed Gini values. This method was used based on the relatively consistent trends of growth or contraction of the Gini in each country in the data set. Extreme changes—namely, of five percentage points or more— in one direction, either increasing or decreasing, and then immediately in the opposite direction in a period of ten years or less are extremely rare. This is to say that the data points of known Gini coefficients provided by WIDER do change, and at times in drastic ways, but they rarely exhibit extreme oscillations in brief time periods. Thus, linear interpolation between known Gini points and extrapolation in relatively short intervals is consistent with the generally smooth movements in the Gini coefficients. This method of calculation works as follows: if two data points fell within ten years of each other, a linear interpolation of Gini indices for each year was made between the two points. For instance, if Guinea had an observed Gini of 55.4 in 1975 and an observed Gini of 60.0 in

1978, the difference (4.6) divided by the number of years falling between the two observed periods (2) would render the value that would be added to the original Gini each year in which an interpolated point was used (thus, for the 1976 Gini 2.3 would be added to 55.4 and so on).

Political Indicator

In order to control for the effect that the type of regime would have on the decision of dissidents to revolt, the regression model incorporates data that measure the political rights accorded citizens of each nation. This information is taken from the Freedom House database. The data used in this paper come from their report on freedom in the world from 1972 to 2006. Political rights are defined as the ability of people "to participate freely in the political process, including the right to vote freely for distinct alternatives in legitimate elections, compete for public office, join political parties and organizations, and elect representatives who have a decisive impact on public policies and are accountable to the electorate." Each country is assigned scores in subcategories concerning the electoral process, political pluralism, and the functionality of the government. The point totals in these subcategories are then used to determine the country's numerical ranking, ranging from 1 to7, which reflects the level of political freedom. Low scores (1-2) indicate a low level of governmental corruption and a high level of electoral functionality. Scores in the middle range (3-5) indicate that a country still demonstrates certain political freedoms even though the political climate is restricted by military involvement in the government, or unfair elections, or vestiges of royal power. Countries with a rating of 6 are ruled by a military junta, religious hierarchies, autocrats, or one-party dictatorships, yet may allow some representation of minority

groups and public opinion through petitions and consultation. In countries with a rating of 7, political rights are absent due to an extremely oppressive government. Freedom House also publishes a civil rights indicator, but the methodology used to calculate the ranking for this category includes the presence of civil conflict. This would create a problem of simultaneity and thus the political rights ranking was chosen to represent the availability of legal means of influencing the government.

Growth

To represent the growth of the stock of resources from which the oligarchs and dissidents extract the growth of the real GDP of each country from year (t-1) to year t is used. The data for growth is taken from the Penn World Table (Summer, Heston, and Aten, 2006). They calculate growth in real GDP using a chain series with prices adjusted for 2000 US dollars. Once again, this is an updated version of the data used by Blomberg and Hess (2002).

Urbanization Rate

The data used to measure the urbanization rates in each country over the period of 1972 to 1999 were taken from the Food and Agriculture Organization (FAO) of the United Nations. The variable was calculated by dividing the number of citizens living in an urban environment by the total population. As mentioned in Muller and Seligson (1987) higher urbanization would tend to decrease the cost of organizing dissent. This may take the form of either legal or extralegal political dissent, thus the influence of urbanization on the likelihood of revolt is unclear.

Cold War

The binary variable used to separate the effect that Cold War financing and instigation of civil conflict might have had on the potential difference in the likelihood of revolutions before and after the end of the Cold War. The end date of the Cold War is defined by the Malta summit held in December 1989 where Mikhail Gorbachev and George Bush officially declared an end to the Cold War (Wright, 2000). The effect of the Cold War on the probability of a revolt beginning in a given year is, like urbanization, not entirely clear. Though strategic financing of dissident movements by either the Soviet Union and or the United States may have increased the likelihood of the ability of dissident groups to initiate civil conflict, the opposite influence of deterrent funding by the opposite power might negate this effect of the Cold War.

Table 1

Country	Gini Average	Political Rights Average	Growth Average	Urbanization Average	Revolution Initiations
Argentina	42.3	2.9	0.7	0.86	1
Armenia	35.6	4.1	4.4	0.65	0
Australia	33.8	1.0	2.0	0.87	0
Austria	26.9	1.0	2.5	0.66	0
Azerbaijan	31.8	5.8	0.9	0.51	1
Bahamas	47.6	1.5	0.6	0.82	0
Bangladesh	38.4	3.9	1.3	0.19	0
Barbados	33.9	1.0	1.1	0.45	0
Belarus	27.0	5.1	7.3	0.69	0
Belgium	27.4	1.0	2.3	0.96	0
Bolivia	53.4	3.0	0.5	0.54	1
Botswana	53.9	2.0	6.2	0.41	0
Brazil	60.5	3.0	2.0	0.73	0
Bulgaria	27.3	5.3	-2.2	0.65	0
Canada	31.4	1.0	2.1	0.77	0
Chile	52.9	4.6	2.3	0.83	0
China	30.7	6.6	7.2	0.28	1
Colombia	56.7	2.4	1.9	0.68	1
Costa Rica	47.1	1.0	1.4	0.53	0
Cote d'Ivoire	46.9	6.0	0.6	0.39	0
Croatia	34.6	3.9	-1.9	0.57	1
Cuba	27.5	6.7	2.8	0.72	0
Czech Republic	21.5	4.9	-0.1	0.74	0
Denmark	31.1	1.0	1.7	0.84	0

Country	Gini Average	Political Rights Average	Growth Average	Urbanization Average	Revolution Initiations
Dominican Republic	47.5	2.9	2.9	0.54	0
Ecuador	51.5	3.1	1.8	0.53	0
Egypt	54.2	5.3	3.0	0.43	1
El Salvador	48.3	3.1	0.9	0.50	1
Estonia	29.5	2.0	-0.7	0.70	0
Finland	25.4	1.5	2.1	0.60	0
France	32.6	1.0	2.1	0.74	0
Georgia	32.8	4.1	-0.9	0.54	0
Germany	31.2	1.8	2.0	0.86	0
Ghana	54.2	5.4	0.8	0.35	0
Greece	38.1	1.8	1.7	0.58	0
Guatemala	54.7	3.6	0.7	0.41	0
Haiti	59.2	6.1	0.5	0.29	2
Honduras	55.3	3.5	0.6	0.40	0
Hungary	23.4	4.1	2.3	0.61	0
Indonesia	42.2	5.5	3.7	0.31	2
Iran	45.4	5.6	0.4	0.56	2
Iraq	63.0	6.9	4.5	0.68	1
Israel	35.8	1.8	2.1	0.90	0
Italy	35.1	1.8	2.2	0.66	0
Jamaica	61.4	1.9	0.1	0.50	0
Japan	32.1	1.3	2.6	0.62	0
Kazakhstan	34.7	5.8	-5.5	0.56	0
Kenya	60.9	5.5	0.3	0.25	0
Kyrgyzstan	34.0	4.4	-0.3	0.36	0
Latvia	27.3	2.0	3.5	0.68	0
Lebanon	60.4	4.9	7.7	0.81	0
Lesotho	65.8	5.0	3.7	0.16	1
Lithuania	26.9	1.4	2.3	0.67	0
Macedonia	33.5	3.5	-0.8	0.59	0
Madagascar	49.1	4.3	-1.8	0.22	0
Malawi	46.3	5.5	2.1	0.11	1
Malaysia	50.3	3.6	5.2	0.50	0
Mauritania	73.6	6.5	0.6	0.42	0
Mauritius	38.2	1.9	4.3	0.42	0
Mexico	53.8	3.7	1.5	0.70	1
Moldova	29.3	3.7	-3.8	0.46	0
Morocco	56.6	4.5	1.8	0.46	1
Nepal	53.6	3.8	1.7	0.09	0
Netherlands	29.6	1.0	1.8	0.60	0
New Zealand	35.1	1.0	1.2	0.84	0
Nicaragua	55.6	4.5	-2.0	0.55	2
Nigeria	52.8	5.3	0.3	0.35	1
Norway	37.3	1.0	3.1	0.72	0
Pakistan	37.6	4.6	2.4	0.30	1
Panama	54.5	4.6	2.6	0.53	0
Paraguay	47.9	4.5	1.9	0.48	0
Peru	54.3	4.1	-0.2	0.68	1
Philippines	48.0	3.6	1.3	0.48	1

Country	Gini Average	Political Rights Average	Growth Average	Urbanization Average	Revolution Initiations
Poland	24.9	4.2	2.7	0.60	0
Portugal	35.8	1.7	3.1	0.42	0
Romania	25.7	5.8	2.9	0.51	1
Russia	32.4	5.4	-3.9	0.68	1
Senegal	59.7	4.2	0.1	0.40	1
Sierra Leone	48.2	5.4	-2.2	0.30	1
Singapore	44.2	4.5	5.0	1.00	0
Slovak Republic	22.3	5.2	0.1	0.57	0
Slovenia	27.8	1.2	1.7	0.51	0
South Africa	51.0	4.0	0.8	0.51	2
South Korea	35.6	4.0	6.3	0.69	1
Spain	33.2	1.9	2.4	0.74	0
Sri Lanka	44.6	2.9	4.0	0.22	0
Sweden	25.7	1.0	1.5	0.83	0
Switzerland	34.6	1.0	1.0	0.64	0
Tajikistan	28.6	6.1	-6.8	0.27	0
Tanzania	57.1	5.8	1.7	0.22	0
Thailand	51.9	3.6	4.7	0.29	2
Trinidad &Tobago	46.6	1.3	1.3	0.68	0
Turkey	49.1	3.1	2.1	0.55	1
Turkmenistan	29.4	6.9	-3.6	0.45	0
Uganda	46.0	5.4	0.1	0.10	0
Ukraine	32.1	3.1	-7.0	0.67	0
United Kingdom	32.9	1.0	2.1	0.88	0
United States	42.0	1.0	2.3	0.75	0
Uzbekistan	31.1	6.8	-1.0	0.38	0
Venezuela	46.3	1.6	-0.2	0.83	0
Zambia	66.2	4.7	-1.4	0.28	0
Zimbabwe	68.5	5.0	0.7	0.33	0
Sample	***41.7***	***3.6***	***1.4***	***0.55***	***36***
Observations	***1746***				

All observations from 1972-1999. Revolts beginning before 1972 and continuing through the observed period were omitted as well as revolts occurring in years for which there was no reported Gini index, growth rate of per capita income, urbanization rate, or political rights variable.

From Table 1 we can see that average Gini value ranges from 21.7 in the Czech Republic to 73.6 in Mauritania and the average Gini value over the entire sample is 41.7. The lowest average political rights value, 1, which indicates the highest level of political freedom, occurs only in Western Europe and anglophone countries with Barbados as the one exception. The highest average political rights indicator occurs unsurprisingly in Iraq. Over the entire sample the average political rights value is 3.6. The highest average growth rate for years in which there were available observations is 7.7 and occurred in

Lebanon. The lowest average growth rate over the time period occurred in Ukraine and is -7.0 while the sample average is 1.4. Nepal averages the lowest urbanization rate at 0.09 while the entirety of Singapore's population is urbanized. The average urbanization rate over the entire sample is 0.55. Not all countries had even data across the time period of 1972-1999. Thus, the panel of data is unbalanced.*

6. Results

As mentioned above a logit model is used to estimate the influence of income inequality on the likelihood of a political revolt. The results are reported below. The sign of each

Table 2
Regression Results

Variable	
C	-9.725
	(-2.520)
Gini	0.164*
	(0.098)
$Gini^2$	-0.001
	(0.001)
Political Rights	0.366***
	(0.100)
Growth (GDP/c)	-0.074***
	(0.028)
Urbanization	-0.185
	(0.848)
Cold War	0.521
	(0.376)
LR-statistic (6df)	40.38
Prob. LR-statistic	0
McFadden R-squared	0.115
Total number of observations	1746
Number of observations = 0	1710
Number of observations = 1	36

Standard errors are shown in parentheses.
* Statistical significance at the 90% level.
** Statistical significance at the 95% level.
*** Statistical significance at the 99% level.

* For a table of the dates of revolts as well as the ranges of the Gini, political rights variable, and number of years of economic contraction see Appendices 2 and 3.

economic variable is as predicted.* As the value of the Gini coefficient and the political rights increase (recall that an increase in the political rights variable is an increase in authoritarianism, not democracy) the likelihood of revolution beginning increases, while an increase in the Gini value squared reduces the likelihood. The linear effect of income inequality on the likelihood of revolution is found to be statistically significant at the 90% level while income inequality squared does not have a statistically significant effect. On the other hand, the political rights variable and per capita GDP growth are both statistically significant at the 99% level. The urbanization rate and the Cold War variables are statistically insignificant.

The LR statistic tests the joint null hypothesis that all slope coefficients are equal to zero, except for the constant. The reported probability of the LR statistic indicates that the variables are jointly significant at the 99% level. The McFadden R-squared value—the analog to the R-squared value in OLS— is 0.115. This indicates a very low level of descriptive significance for the regression as a whole.

As mentioned above, the marginal effect of variable m on the dependent variable in a logit model takes the form: $\frac{\partial \Pr}{\partial x_m} = \beta_m \frac{e^{BX}}{(1+e^{BX})^2}$. To give an idea of how an unit increase in any of the variables would affect the likelihood of a revolt being initiated it would be useful to evaluate this marginal effect at a variety of values. Listed below are the median values of each variable for five distinct regions of the world.

* See Appendix 5 for a correlation table. Note the high correlation between urbanization rate

Table 3
Median values by Region

Region	*Gini*	*Growth*	*Political Rights*	*Urbanization*
Africa	54.0	0.78	5	0.33
Asia	39.5	4.07	4	0.33
Europe & Nor. Am.	29.5	2.30	1	0.70
Latin America	52.4	1.40	3	0.57
Middle East	46.0	2.35	5	0.63

Included in Europe and North America are New Zealand and Australia. Latin America also includes nations from the Caribbean.

In order to evaluate the effect of an increase in inequality in the "median nation" in Africa, for instance, the median values of each variable and the parameter estimations of β_0 through β_6 are used to determine the value of $\frac{e^{BX}}{(1+e^{BX})^2}$. Then, multiplying this value by the estimated coefficient of the variable of interest renders the effect of a unit increase of that variable on the likelihood of revolution commencing in the given year in the "median nation" of Africa. Below is a table of the marginal effect of a unit increase in each of the variables on the likelihood of revolution in the constructed median nations in each region.

Table 4
Marginal effects on median countries

Region	*Gini*	*Polt. Rights*	*Growth*	*Urbanization*
Africa	0.0030	0.0070	-0.00141	-0.0035
Asia	0.0039	0.0092	-0.00185	-0.0046
Europe and Nor. Am.	0.0010	0.0022	-0.00044	-0.0011
Latin America	0.0038	0.0088	-0.00178	-0.0044
Middle East	0.0030	0.0070	-0.00141	-0.0035

All effects estimated for post-Cold War years

Since the estimated parameters for each of the variables in the sample applies to each region the difference in the marginal effect of each of the variables across regions is determined by the magnitude of the summed vector of median variables and their corresponding coefficients for each region. Asia has the highest summed value of

$\frac{e^{BX}}{(1+e^{BX})^2}$, so a unit change in any of the variables has the greatest effect in the median country in Asia while it has the lowest net effect in the median countries in Europe and North America.

It would also be interesting to know the likelihood of revolution occurring in the "average year" of the sample. In order to calculate this, the average values of each variable across the entire sample would be substituted into the logit model along with the estimated coefficients. Thus, on average, a country in a post-Cold War year preceding 1999, accounting for income inequality, political openness, economic growth, and urbanization rate, would experience the initiation of a revolt with probability of:

$$\Pr(Y=1) = \frac{e^{-9.75+0.164(41.7)-0.001(1738.89)+0.366(3.6)-0.074(1.4)-0.185(0.55)}}{1+e^{-9.75+0.164(41.7)-0.001(1738.89)+0.366(3.6)-0.074(1.4)-0.185(0.55)}} = 0.028$$

7. Conclusion

The theoretical model of economic costs and benefits faced by a dissident group that extracts resources from a common stock of resources (e.g. fish or lumber) shared by the government is developed and extended in this paper. While Blomberg, Hess, and Weerapana (2004) apply their model to individual countries over time, the model is here used to understand how the probability of a revolt being initiated in a given year would change with variations in economic variables as well as political variables across countries and over time. An additional alteration of the model of Blomberg, Hess, and Weerapana is incorporation of the relative extraction rates of the dissidents and oligarchs in the likelihood of successful revolt. This adjustment to the model implies a declining probability of success as extraction rate inequality increases. Declining expected success

but increasing payoff as inequality increases implies the highest rate of revolution initiation in instances of moderate income inequality.

In empirically examining the effect of differing extraction rates by using the proxy of income inequality, while controlling for other variables the predicted effect of each variable was found. Higher income inequality increased the likelihood of revolt commencing in a given year but at a declining and eventually negative rate. However, the effect of the $Gini^2$ on the probability of revolt initiation was not found to be statistically significant, nor was the effect of the Cold War or urbanization. The Gini was found to be statistically significant in its effect, but not at an extremely high level.

Further examination of the effect of income inequality in the decision of dissident groups to violently revolt against the government would hopefully account for the level of divisiveness in each country in a given year. Collier and Hoeffler (2004) suggest ethno-linguistic fractionalization indices and measurements of the percentage of the population belonging to the dominant ethnic group. Variables for the level of education and literacy may play a role in determining the cost of revolt as well.

Additional consideration might also be given to the role that expectations of the duration of conflict as well as the effect of conflict on growth might be incorporated in the model.

Appendix 1

Partial of payoff to revolt with respect to γ:

$$\frac{\partial}{\partial\gamma}N^R(\tau)=(\frac{\partial}{\partial\gamma})(-q^R\int_{\tau}^{\tau+h}\delta a_0e^{(\beta-\gamma-\delta-p)s}ds+\theta\int_{\tau+h}^{\infty}(\gamma-\delta)a_0e^{(\beta-\gamma-\delta-p)s}ds)$$

$$=(\frac{\partial}{\partial\gamma})-q^R\int_{\tau}^{\tau+h}\delta a_0e^{(\beta-\gamma-\delta-p)s}ds+(\frac{\partial}{\partial\gamma})\theta\int_{\tau+h}^{\infty}(\gamma-\delta)a_0e^{(\beta-\gamma-\delta-p)s}ds$$

$$=(-\gamma)-q^R\int_{\tau}^{\tau+h}\delta a_0e^{(\beta-\gamma-\delta-p)s}ds+(\frac{\partial}{\partial\gamma}\theta)\int_{\tau+h}^{\infty}(\gamma-\delta)a_0e^{(\beta-\gamma-\delta-p)s}ds$$

$$+\theta(\frac{\partial}{\partial\gamma}\int_{\tau+h}^{\infty}(\gamma-\delta)a_0e^{(\beta-\gamma-\delta-p)s}ds)$$

$$=(\gamma)q^R\int_{\tau}^{\tau+h}\delta a_0e^{(\beta-\gamma-\delta-p)s}ds+(\frac{\partial}{\partial\gamma}\theta)\int_{\tau+h}^{\infty}(\gamma-\delta)a_0e^{(\beta-\gamma-\delta-p)s}ds$$

$$+\theta(\int_{\tau+h}^{\infty}a_0e^{(\beta-\gamma-\delta-p)s}ds+\int_{\tau+h}^{\infty}(\gamma\delta-\gamma^2)a_0e^{(\beta-\gamma-\delta-p)s}ds)$$

$$=(\gamma)q^R\int_{\tau}^{\tau+h}\delta a_0e^{(\beta-\gamma-\delta-p)s}ds+(\frac{\partial}{\partial\gamma}\theta)\int_{\tau+h}^{\infty}(\gamma-\delta)a_0e^{(\beta-\gamma-\delta-p)s}ds+\theta(\int_{\tau+h}^{\infty}(1+\gamma\delta-\gamma^2)a_0e^{(\beta-\gamma-\delta-p)s}ds)$$

$$=(\gamma)q^R\int_{\tau}^{\tau+h}\delta a_0e^{(\beta-\gamma-\delta-p)s}ds+[(\frac{\partial}{\partial\gamma}\theta)(\gamma-\delta)+\theta(1+\gamma\delta-\gamma^2)]\int_{\tau+h}^{\infty}a_0e^{(\beta-\gamma-\delta-p)s}ds$$

The constant of oligarch extraction rate multiplied by the proportion of income expended by the dissident group comes out to a positive value. The partial derivative of the likelihood of success, θ, is known to be negative, that is, as the oligarch extraction rate increases the likelihood of successful revolt falls. Given that the oligarch extraction rate is known to exceed the dissident extraction rate, the first product within the brackets is negative. In spite of knowing that the oligarch extraction rate squared is greater than the product of the oligarch extraction rate and the dissident extraction rate, we cannot sign the second product.

Appendix 2

Table 5
Dates of "revolts"

Country	Start Date	End Date	Country	Start Date	End Date
Argentina	1977	1980	Malawi	1977	1977
Azerbaijan	1988	1997	Mexico	1994	1994
Bolivia	1980	1980	Morocco	1975	1989
China	1988	1997	Nicaragua	1978	1980
China	1989	1989	Nicaragua	1981	1990
Colombia	1984	n/a	Nigeria	1980	1981
Croatia	1991	1995	Pakistan	1971	1971
Egypt	1986	1996	Peru	1982	1997
El Salvador	1979	1992	Philippines	1972	n/a
Haiti	1986	1986	Russia	1991	1996
Haiti	1991	1991	Senegal	1991	n/a
Indonesia	1975	1992	Sierra Leone	1991	n/a
Indonesia	1997	n/a	South Africa	1976	1977
Iran	1977	1979	South Africa	1984	1996
Iran	1981	1983	Sri Lanka	1983	n/a
Iraq	1980	n/a	Thailand	1976	1978
South Korea	1979	1979	Thailand	1993	n/a
Lesotho	1998	1998	Turkey	1984	n/a

Dates of revolution commencement and conclusion taken from the State Failure Task Report (2000). These are the revolts that occur between 1972 and 1999 and have corresponding observations for the various economic and political determinants listed above. An entry of n/a indicates that the conflict had not ended by 1999.

Appendix 3

Table 6
Ranges of Gini values, political rights, years of economic contraction

Country	Gini Range	Political Rights Range	Years of Negative Growth
Argentina	36.1, 47.9	1, 6	11
Armenia	25.9, 62.5	3, 5	1
Australia	29.4, 39.4	1, 1	4
Austria	22.7, 31.6	1, 1	3
Azerbaijan	25.2, 50.1	5, 6	2
Bahamas	39.1, 62.5	1, 2	12
Bangladesh	33.6, 45.0	2, 7	8
Barbados	30.9, 46.4	1, 1	10
Belarus	22.7, 29.7	4, 6	0
Belgium	22.5, 32.1	1, 1	4
Bolivia	49.4, 60.2	1, 7	10
Botswana	53.7, 54.0	1, 3	3
Brazil	57.9, 64.0	2, 5	9
Bulgaria	17.8, 42.2	2, 7	5
Canada	27.4, 33.9	1, 1	4
Chile	44.0, 57.2	1, 7	6
China	27.3, 37.3	6, 7	1
Colombia	50.8, 63.7	2, 4	4
Costa Rica	43.2, 48.1	1, 1	7
Cote d`Ivoire	43.9, 50.6	6, 6	15
Croatia	31.2, 37.9	3, 4	3
Cuba	27.0, 28.3	6, 7	9
Czech Republic	18.7, 26.5	1, 7	3
Denmark	22.5, 40.6	1, 1	6
Dominican Republic	43.4, 53.0	1, 4	4
Ecuador	44.4, 58.8	2, 7	9
Egypt	54.2, 54.2	4, 6	4
El Salvador	44.9, 56.0	2, 5	8
Estonia	24.0, 40.1	1, 3	4
Finland	19.6, 30.9	1, 2	6
France	29.3, 42.5	1, 1	2
Georgia	24.8, 49.8	3, 6	3
Germany	27.3, 39.3	1, 2	5
Ghana	50.9, 63.2	3, 7	6
Greece	32.6, 44.9	1, 7	9
Guatemala	54.0, 56.0	2, 6	10
Haiti	59.2, 59.2	4, 7	12
Honduras	52.7, 59.1	2, 7	8
Hungary	20.9, 29.2	1, 6	6
Indonesia	38.7, 51.0	4, 7	6
Iran	43.6, 46.0	5, 6	13
Iraq	63.0, 63.0	6, 7	13
Israel	34.8, 37.2	1, 2	6

Country	Gini Range	Political Rights Range	Years of Negative Growth
Italy	30.4, 42.1	1, 2	3
Jamaica	54.0, 65.5	1, 2	17
Japan	21.9, 36.9	1,2	4
Kazakhstan	25.7, 53.0	5, 6	5
Kenya	57.0, 70.0	4, 7	13
Kyrgyzstan	24.3, 61.3	4, 5	2
Latvia	22.5, 34.6	1, 3	0
Lebanon	60.4, 60.4	2, 6	2
Lesotho	63.0, 69.0	3, 7	10
Lithuania	23.7, 33.7	1, 2	2
Macedonia	29.5, 45.3	3, 4	5
Madagascar	39.1, 62.5	2, 6	21
Malawi	42.5, 53.1	2, 7	9
Malaysia	49.1, 50.6	2, 5	4
Mauritania	71.4, 76.2	6, 7	7
Mauritius	35.2, 41.9	1, 3	2
Mexico	49.9, 59.2	3, 5	6
Moldova	22.9, 40.5	2, 5	5
Morocco	54.0, 59.0	3, 6	3
Nepal	52.0, 54.6	3, 6	5
Netherlands	25.8, 34.4	1, 1	4
New Zealand	30.2, 40.1	1, 1	8
Nicaragua	55.5, 55.7	2, 5	17
Nigeria	47.9, 61.8	2, 7	14
Norway	31.3, 43.5	1, 1	1
Pakistan	34.0, 41.0	3, 7	3
Panama	47.6, 58.7	1, 7	8
Paraguay	39.8, 62.1	3, 6	11
Peru	50.9, 57.0	2, 7	14
Philippines	45.5, 53.3	2, 5	11
Poland	20.1, 31.0	1, 6	7
Portugal	32.9, 42.1	1, 5	4
Romania	20.4, 29.4	2, 7	9
Russia	23.9, 47.6	3, 7	7
Senegal	43.0, 68.0	3, 6	10
Sierra Leone	46.0, 49.0	3, 7	13
Singapore	37.0, 47.0	4, 5	3
Slovak Republic	18.6, 26.3	1, 7	4
Slovenia	19.9, 30.7	1, 2	2
South Africa	45.0, 60.0	1, 5	8
South Korea	31.6, 40.2	2, 5	2
Spain	31.5, 34.2	1, 5	5
Sri Lanka	40.9, 47.5	2, 4	2
Sweden	19.9, 36.7	1, 2	6
Switzerland	30.9, 35.9	1, 1	5
Tajikistan	25.2, 33.4	3, 7	5
Tanzania	43.3, 72.0	4, 6	16
Thailand	42.8, 58.5	2, 7	4
Trinidad &Tobago	41.7, 51.7	1, 2	12

Country	Gini Range	Political Rights Range	Years of Negative Growth
Turkey	43.8, 52.0	2, 5	9
Turkmenistan	25.4, 35.8	6, 7	3
Uganda	39.9, 54.6	4, 7	6
Ukraine	21.9, 47.0	3, 4	5
United Kingdom	30.9, 35.2	1, 1	5
United States	37.4, 45.9	1, 1	5
Uzbekistan	24.8, 48.1	6, 7	4
Venezuela	42.6, 51.2	1, 4	14
Zambia	55.6, 77.6	2, 6	13
Zimbabwe	62.3, 73.1	3, 6	9

Appendix 4

Table 7
Correlation matrix

Variable	*Urbanization*	*Polt. rights*	*Growth*	*Gini*	*Cold war*
Urbanization	1.000	-0.523	0.048	-0.365	-0.148
Polt. Rights	-0.523	1.000	0.005	0.335	0.162
Growth	0.048	0.005	1.000	-0.080	0.059
Gini	-0.365	0.335	-0.080	1.000	-0.056
Cold war	-0.148	0.162	0.059	-0.056	1.000

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